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ABSTRACT

The goal of industrial vocational education is reached only when the technical personnel it prepares find employment in a technological world and enjoy their working experience. Technological upgrading and economic advancement in Taiwan necessitate drastic revisions and improvements in the personnel development program. The government has been improving various areas relating to industrial personnel development, especially as a result of the Industrial Vocational Education Improvement Project. Improvements and innovations are being introduced in each of these areas: teacher training, curriculum, equipment and facilities, teaching material and teaching method, the certification program, cooperative education, evaluation, occupational ethics, administration and management, and the school system. A major focus is balancing technical training with human development. (YLB)

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Presentation

Taiwan Industrial Vocational Education: The Personnel Development Program

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台灣工業職業教育對經建人力發展所扮演的角色

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Introduction

This is a world of technology and a period of rapid change, in which human beings are constantly developing new inventions by using their brain power and amazing determination to improve their quality of living and pursue a better life. This is also a world of "knowledge explosion". The great advancement in science and technology has brought to the employed workers an impetus to renew and upgrade their skills. On the other hand, it would be unlikely or even impossible for a technical worker to return to his position without upgrading and retraining in occupational skills after he was away from the workplace for a period of, say, ten years. While new and more sophisticated products are made and substituting for the out-dated ones, new professions are created. Some of the high-tech products such as robots, microprocessors and computers have immensely altered our society and will cause rapid changes to the vocational skills required. This has beocme an unprecedented challenge upon the industrial vocational education today.

Taiwan as an island country is liable to be affected economically by the global marketplace. Hence, the government of the Republic of China has been investing a total of NT$ 292.2 billion budget for science and technology development during the period of 1983-1990

with a view to increasing industrial productivity and accelerating the upgrading of technology. In addition, in 1984 the Institute for Information Industry was founded, which was to help train the information science personnel to cope with the rapidly changing information age. The Three Phases of Industrial Vocational Education Improvement Project, which costs more than NT$ 7 billion, was initiated by the Ministry of Education in 1979 to help the industrial technical education keep pace with the national economic development. The Project include purchasing shop machinery and laboratory equipment for instructional purposes, and teachers retraining programs. The industrial vocational education of the Republic of China will make great strides once the Project is completed.

A Brief History of Modern Industrial Vocational Education of Taiwan, Republic of China

Taiwan industrial vocaitonal education has been greatly advanced in the past 30 years since the seat of the Central Government was moved to the island of Taiwan in 1949. In February 1953 the Sino-American Conference on Industrial Vocational Education, sponsored by the Ministry of Education of ROC, was held. Several topics on technical education and manpower training programs were discussed, and an era of cooperation in industrial

vocational education between the United States and the Republic of China began. A fact-finding group was organized to visit and have a better understanding of the industrial vocational education institutions of both secondary and post-secondary levels.

The Unit Trade System has been prevailing in Taiwan industrial vocational education for over thirty years. When the nine-year compulsory education system was implemented in 1968, the three-year vocational junior high school system, which had in the past been regarded as part of the secondary education was at the same time abolished. The establishment of vocational high school and vocation-oriented five-year junior college (both admit junior high graduates) by private sectors was encouraged to meet the needs of national reconstruction. The number of students enrolled in the vocational school system has been increasing, and the ratio of vocational school students and high school students (academic-oriented) was 71.6% to 28.4% in 1984, representing a great increase in the number of students receiving vocational training compared to that of 40% to 60% in 1956. Figure 1 through figure 3 reveal some major facts about education of all levels in Taiwan, Republic of China, while figure 4 shows the educational statistics of Taiwan contrasted with those of some other countries in

School Year	Elementary School	Junior High School	Senior High School	Senior Voc. School	Junior College	University	Graduate School	Special Education Institute	Supplementary School
1953	1,060,324	114,302	21,793	21,828	4,240	7,687	16	602	7,479
1956	1,344,432	174,180	37,253	32,393	5,025	17,309	272	821	12,864
1961	1,997,016	294,334	62,548	52,680	8,366	29,524	513	1,509	15,914
1966	2,307,955	500,879	127,490	85,714	47,499	65,245	1,111	2,118	34,125
1971	2,456,615	847,660	190,798	199,833	119,146	100,455	2,904	2,879	109,705
1976	2,341,413	1,058,870	181,933	298,347	154,056	140,857	4,501	2,921	174,686
1981	2,213,197	1,70,942	182,397	374,319	192,901	158,181	7,355	2,576	248,438
1984	2,273,390	1,077,732	192,360	407,832	227,492	173,908	10,981	2,883	270,088
1985	2,321,700	1,062,226	194,757	421,784	236,824	179,334	12,418	2,954	266,131
Average Yearly Increase (%)									
1954 – 1961	8.2	12.6	14.1	11.6	8.9	18.3	54.3	1.3	9.9
1962 - 1971	2.1	11.2	11.8	14.3	30.4	13.0	18.9	6.7	21.3
1972 - 1981	-0.01	2.4	-0.005	6.5	4.9	4.6	9.7	-0.01	8.5
1954 - 1984	2.5	7.5	7.3	9.9	13.7	10.6	23.5	5.2	12.3
Increase in 1953 - 1984 (times)	1.1	8.4	7.8	17.7	52.7	21.6	685	3.8	35.1

Figure 1. Number of Students at All Levels 1953 - 1985 in Taiwan, Republic of China.

School Year	Student and Population Ratio	Percentage of School Children to School-Aged Children (age 6-12)	Percentage of Elem. School Graduates Entering Junior High Schools	Percentage of Junior High School Graduates Entering Senior Secondary School	General High School Enrollment Ratio to Vocational High School Enrollment	Average Number of College Students (Not Including 1-3 Grades of 5-yr Jr. Col.) in a Population of 100,000	Ratio of the Number of University Students Majoring in Science and Technology to the Number of Those Majoring in Humanities and Social Sciences	Ratio of Graduate School Enrollment to That in Higher Education	Ratio of Enrollment in Elementary, Secondary and Higher Education
1953	14.7	87.8	35.6	67.0	-	126	-	-	86.2:12.8:1.0
1956	17.2	93.8	46.7	73.0	59.4:40.6	239	-	1.2	83.5:15.1:1.4
1961	22.0	96.0	52.5	81.9	57.8:42.2	329	-	1.3	81.7:16.8:1.6
1966	24.3	97.2	59.0	79.8	51.0:49.0	669	-	1.0	73.6:22.8:3.6
1971	26.7	98.0	81.4	71.4	43.6:56.4	1,101	40.0 : 60.0	1.3	62.7:31.6:5.7
1976	26.3	99.4	91.0	60.0	33.0:67.0	1,420	40.0 : 60.0	1.5	56.0:36.8:7.2
1981	24.5	99.8	97.4	68.7	28.0:72.0	1,518	45.2 : 54.8	2.1	52.7:38.8:8.5
1984	24.3	99.8	99.3	71.0	28.4:71.6	1,689	45.7 : 54.3	2.7	52.1:38.5:9.4

Figure 2. A Brief Index of Educational Development in Taiwan, Republic of China 1953 - 1984.

Classification	School Year 1979 - 1980	School Year 1984 -1985	number of Increase	Percentage of Increase
1. Total Educational Expenditures (NT$ million)	43,269	110,844	67,575	156.2
2. Ratio of Educational Expenditures to GNP (%)	4.1	5.2		1.1
3. Number of Students at all levels (person)	4,404,967	4,636,666	231,699	5.3
4. Students and Population Ratio (%)	25.1	24.3		-0.8
5. Percentage of School Children to School-Aged Children (age 6 - 12)	99.7	99.8		0.1
6. Percentage of Elementary School Graduates Entering Junior High School	96.2	99.3		3.1
7. Percentage of Junior High School Graduates Entering Senior Secondary Schools	62.4	71.1		8.7
8. Number of Students in the First Year of Senior High Schools	67,158	70,310	3,152	4.7
9. Number of Students in the First Year of Senior Vocational Schools	122,974	147,018	240,044	19.6
10. Number of Students in the First Year of Five-Year Junior Colleges	26,415	30,683	4,268	16.2
11. Number of Students in the First Year of Two-Year and Three-Year Junior Colleges (day session)	13,581	17,493	3,912	28.8
12. Number of Students in the First Year of Universities (day session)	27,562	31,145	3,583	13.0
13. Number of Students in the First Year of Master Program	2,304	4,299	1,995	86.6
14. Number of Students in the First Year of Ph.D. Program	146	457	260	213.0

Figure 3. A Comparison of Educational Statistics in 1979 and in 1984.

Country	Year	Average Number of Students in a Population of 100,000	Percentage of enrollments in Graduate schools, Universities and Junior Colleges			Percentage of Enrollments in Elementary, Secondary and Higher Education		
			Graduate School	University	Junior College	Elementary Education	Secondary Education	Higher Education
United States	1965 1980	2,840 5,100	- 19.6	- 46.7	- 33.7	58.5 50.5	31.4 26.8	10.1 22.7
Canada	1965 1981	1,473 3,815	- 8.6	- 61.6	- 29.8	67.4 41.3	25.7 42.1	6.9 16.6
France	1965 1980	940 1,619	- 17.2	- 73.1	- 9.7	59.3 42.4	35.0 47.5	5.7 10.1
West Germany	1965 1980	455 1,987	- 1.4	- 83.0	- 15.7	71.5 46.4	23.7 41.8	4.8 11.9
United Kingdom	1965 1980	352 1,487	- 12.1	- 59.1	- 28.8	56.7 44.3	38.8 48.2	4.5 7.5
Australia	1965 1981	1,101 2,238	- 13.0	- 65.9	- 21.1	61.5 54.3	33.6 35.3	4.9 10.4
Japan	1965 1980	1,017 2,066	- 2.4	- 80.0	- 17.6	45.6 49.0	49.0 41.1	5.4 9.9
South Korea	1965 1981	500 2,031	- 5.7	- 68.2	- 26.2	78.6 51.9	19.1 40.8	2.3 7.2
Republic of China	1965 1984	530 1,632	- 2.4	- 42.9	- 54.7	74.3 51.9	22.9 38.9	2.8 9.2

Figure 4. A Statistical Comparison of Education in the Republic of China with Some of Other Countries.

the world.

There were only three vocational training institutions at college level in the year 1950. However, in 1984 the total number of various types of junior colleges reached 77, which provided all sorts of technicians needed by the nation for its economic development. The Fifth National Education Conference held in 1970 decided that the technical and vocational education system should be more flexible and that the system should include vocational high school, junior college and senior institute of technology -- a parallel of university. Hence, the National Taiwan Institute of Technology, aiming to train engineers through its undergraduate and graduate programs, was established in 1974. A technological educational system was eventually completed, which was able to provide all levels of technical manpower -- skilled workers, technicians and engineers required by the industry in the process of the nation's economic development.

Industrial Vocational Education In Relation to the National Economic Development of the Republic of China

The economic, societal, political and cultural development of a nation, even its security, depends mainly on advanced scientific and technological skills.

High quality manpower is always considered as the key element in upgrading science and technology. In the Republic of China, as well as in other countries of the world, the major goal of industrial vocational education is to provide sufficient technical personnel of all levels both in quantity and quality. It is not to be negligible that the training system should be carefully planned and that it needs timely changes to satisfy the requirements of the "work world" as the industry develops. Figure 5 demonstrates the rapid growth of technical engineering personnel needed, especially those of middle and lower levels, in the period of 1981-1991 in Taiwan, Republic of China.

Year	Total	Engineers		Technicians	
	Percentage	Number	%	Number	%
1981	2.4	68,070	1.0	93,450	1.4
1991	4.1	136,790	1.6	213,520	2.5

Figure 5. Number and percentage of technical engineering personnel in 1981 in comparison with those in 1991 as predicted

While Taiwan in its transitory stage is shifting from labor intensive industry to capital and technology intensive industry, technological manpower of higher

quality is urgently needed. Industrial vocational education has been playing an increasingly important role in the process of Taiwan industrial development. Another important action the government took to upgrade the nation's industrial technology skills is the founding of Industrial Technology Research Institute in 1973. The Institute consist of six departments and laboratories; namely, Mechanical Engineering, Electronics Engineering, Chemical Engineering, Industrial Material Engineering, Energy and Mining. The ITRI has successfully developed many kinds of new high-tech products of high commercial value. The ITRI helps private sectors increase the competitiveness of their products by transferring the related technologies to them for mass production. The high-level manpower training programs provided by the ITRI not only enrich the contents but also encourage the innovation of industrial vocational training in the Republic of China.

The Personnel Development Program
for Industrial and Technological
Upgrading in Taiwan, Republic of China

The goal of industrial vocational education is reached only when the technical personnel it prepares find employment in a technological world and enjoy their working experience. Therefore, technology upgrading and

economic advancement in Taiwan necessitate drastic revisions and improvements on the personnel development program. It is generally acknowledgd that no progress in education means waste of time and resources, which might even cause great loss to a nation. In the following section will be presented a general discussion on such topics relating to industrial personnel development as teacher training, curriculum, equipment, teaching material and teaching method, management, certification program, cooperative education, evaluation, vocational ethics, and school system. Improvement procedures for each area will also be proposed.

Teacher Training

Presently, the Industrial Education Department in National Taiwan Normal University, National Kaohsiung Teachers College and National Taiwan College of Education assumes the major responsibility for preparing industrial vocational high school teachers. The majority of teachers in junior colleges and Taiwan Institute of Technology, like those in other colleges and universities, have earned master's degree or doctorate degree. In recent years the Ministry of Education has been offering financial assistance to technology teachers receiving in-service training, primarily in automation and information science programs in post baccalaureate

institutions.

To keep pace with the upgrading of the industry, we should enhence teacher preparation and retraining programs with emphasis on: (a) professional knowledge and skills as well as shop practice experience, (b) effective teaching method and advanced technological skills, (c) life-long education so that teachers will continually educate themselves in their teaching career, and (d) communication and cooperation between teachers and industries in the community. Thus teachers can enrich their professional knowledge and experience; on the other hand, teachers are encouraged to offer the local citizens educational services.

Curriculum

There are definite educational goals for all levels of industrial vocational education system. The National Taiwan Institute of Technology admits graduates of junior colleges for its two-year program and graduates of vocational high schools for its four-year program. Its major goal is to cultivate high level engineering and management personnel. The vocational high school prepares students to be entry level skilled workers by providing them with basic vocational knowledge as well as technological skills and occupational morality.

The fast advancing technology and rapidly changing

society call for innovations on curricula and adjustment of programs. Some of the major actions to be taken include: (a) regular revisions on industrial vocational education programs and curricula based on the trade analyses and responses from the industry and (b) more flexibility in selective courses by offering more related to information science and automation technology.

The traditional unit-trade training program, which has prevailed since it was introduced to Taiwan in 1953, seems unable to meet the needs of employment market due to the industrial development and technological change. Hence, in March 1984 a draft of Cluster Ladder Program was completed, which was inspired by Dr. Donald Maley's Cluster Concept in Vocational Education. According to the Cluster Ladder Program, the current thirty-two departments are grouped into five clusters: mechanical engineering, electrical engineering and electronics, civil engineering and architecture, chemical engineering, and industrial arts. The Cluster Program is now undergoing its experimental process. It is also significant that each industrial vocational institution develops its unique program to meet the needs of the local area.

Equipment and Facilities

An old Chinese proverb says, "Good tools are

prerequisite to the successful execution of a job." Sufficient and up-to-date equipment and instructional facilities no doubt help make quality education and training possible. The Government of the Republic of China has been doing tremendous efforts to improve the instructional equipment and laboratories in the past decade. More emphasis should be laid on the following: (a) increase shop equipment required for new curriculum and industrial development, particularly that for information technology and automation training, (b) purchase school shop and laboratory equipment following the rule of "Life Cycle Cost Method" to take full advantage of the equipment, (c) substitute modern equipment for outdated equipment regardless of regular duration limit rules, (d) The government provides loans for schools through banks, or organizes educational foundation to finance expenses on instructional equipment, (e) encourage the cooperation in research and development between schools and industries by allowing the private sectors to be exempt from taxes on the machines set aside for educational purposes, and (f) more careful maintenance of equipment to get it always ready for use.

Teaching Material and Teaching Method

Either teaching material or teaching method plays an

important part in a personnel development program. Appropriate teaching material and good teaching method can not only motivate students to learn but also lead to satisfactory teaching effect. The following strategies can not be neglected: (a) better rewarding for valuable textbooks written by teachers, who may become more devoted, (b) more use of audio-visual equipment, (c) explore innovative teaching methods through educational seminars and teaching demonstrations, (d) coordinate theory and practice by advising students to do more independent study and research, (e) better library service available to both teachers and students, and (f) regular and irregular evaluation on teaching materials and teaching methods for improvement.

Certification Program

Presently, the certification program administered on the technical personnel includes three levels. Those who successfully meet the requirements of each level of standard are awarded the certificate. More than 120,000 technicians in fifty occupational titles were cerfificated during the period of 1973-1981. Although the certification program has been practiced for more than a decade, it does not receive the recognition of the industry as it deserves. Therefore, the certification program needs improvements in policy and changes in

occupational titles. On the other hand, the industries are encouraged to differentiate the certificated employees from the others by giving higher pay to the former than the latter.

Cooperative Education

Cooperative education implies a joint effort of industries and educational institutions to improve industrial education through the plan that students obtain working experience from industries while teachers upgrade their technological knowledge and skills through study and research work in industries. To accomplish the objective of a cooperative education program, we should concentrate on: (a) better understanding of the program through more communication among students, parents, schools and industries, (b) recognizing the key role coordinators of the program play, (c) careful supervision of the cooperative program, and (d) follow-up steps and regular appraisal procedures which can lead to constant revision and improvement on the program.

Evaluation

Obviously, evaluation is intended to improve the operations of a personnel development program. Since 1975 the industrial education institutions in Taiwan have undertaken evaluation by educational authorities every three years in such fields as teachers, curriculum and

instruction, library and equipment, student practice and experiment, placement, and administration. These educational institutions have profited a lot from the enforcement that evaluation offers. The following should be given more attention if evaluation efforts are to serve its purposes: (a) The people directly involved in evaluation operations should be carefully selected among those who are profoundly experienced in teaching and industrial employment, and (b) program evaluation requires careful design and preparation; data of different kinds and those from different sources need to be gathered so that evaluation may prove diagnostic as well as objective.

Occupational Ethics

The goal of industrial vocational education is to promote cognitive, affective and psychomoter development of students. Affective development means the cultivation of professional morality and ethics. Accordingly, an industrial education program is not only to provide students with technological knowledge and skills but also to develop positive attitudes toward work and loyality to the organization they work for. Therefore, a personnel development program should include: (a) education to enable students to adapt themselves to the ever changing technological world through their own life-long

education, (b) training on the principle of public welfare and public morality, and (c) student organization activities, from which the participants learn the organizational rules.

Administration and Management

An efficient administration system can insure the success of a personnel development program by creating a satisfactory teaching and learning environment. Some important items among others the administration should center on are: (a) Those in charge of the development program should have majors in industrial vocational education, (b) to enforce the policy of work simplification and administration computerization, (c) to provide preservice and in-service training for administrative personnel, (d) to better the capability and leadership of top-level administrator, and to dismiss those incompetent staffs through sound evaluation procedures, (e) more participation of school employees in decision-making, and (f) to have rigid rules on the office term of the president and top-level administrators of industrial vocational education institutions.

School System

Figure six presents the current industrial vocational education system, including secondary and post-secondary levels of institutions. They are three-year vocational

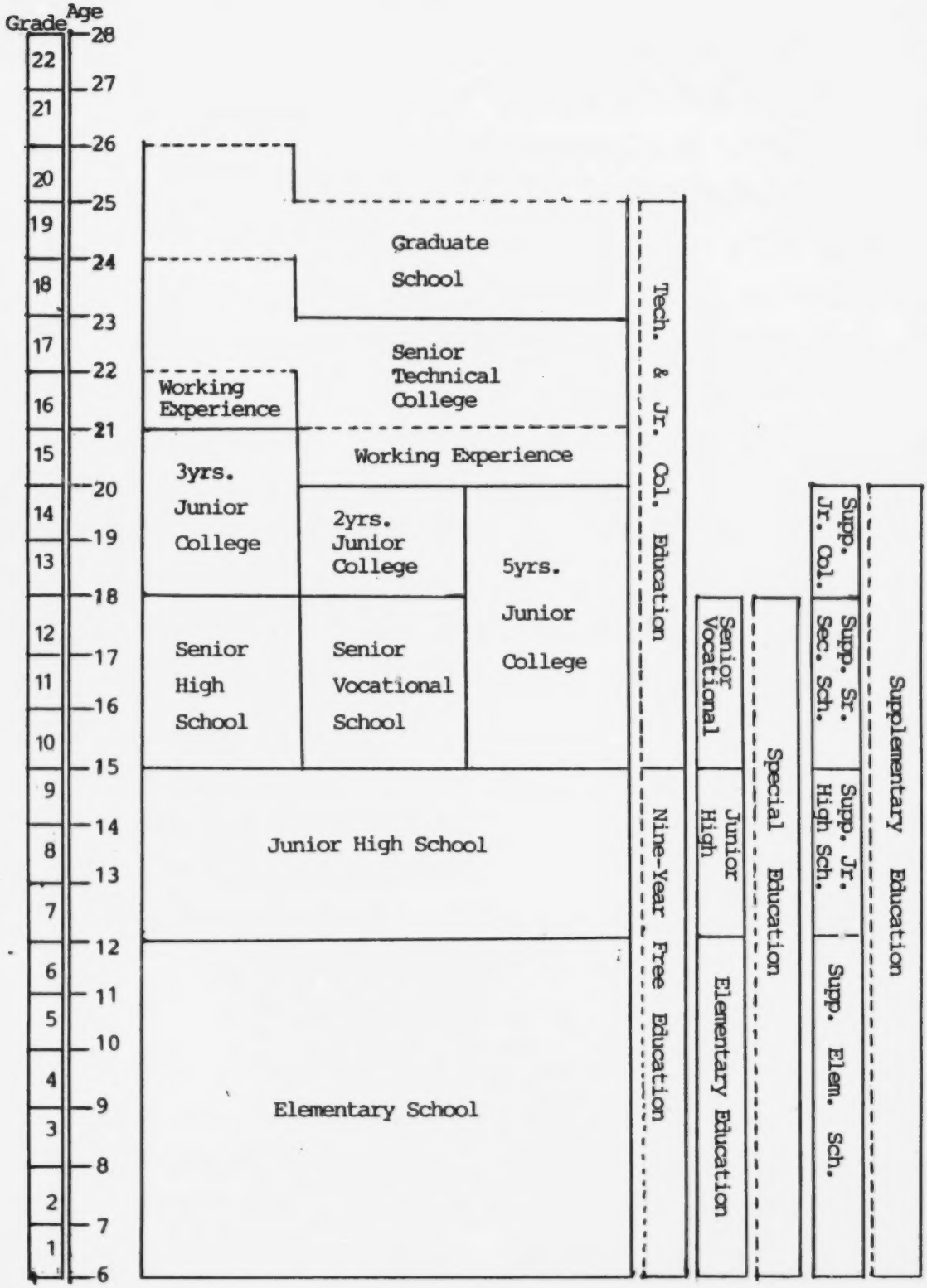

Figure 6. The Current Industrial Vocational Education System in Taiwan, Republic of China

high school, five-year junior college (admitting junior high school graduates), two-year college (admitting industrial high school graduates), and National Taiwan Institute of Technology taking in graduates from five-year and two-year industrial junior colleges. (Another undergraduate program admits graduates from industrial vocational high schools.) More efforts in relation to school system, as stated below, need to be made so as to cope with the upgrading of industrial technology: (a) Universities offer more technology- related programs to industrial vocational high school and junior college graduates for advanced study, (b) to establish more college-level institutes of technology to cultivate high-level technical manpower, (c) Each industrial vocational institution develops its unique programs to meet the needs of the local community and industry, (d) to improve the quality of private school education by providing more government grants and through other supervising behaviors, and (e) to provide more retraining programs at all levels for technical personnel so that they can cope with the changes in the work world.

Conclusion

The industrial vocational education in Taiwan, Republic of China has greatly been improved in both quantity and quality during the last three decades. We

are continuously advancing toward a complete system of life-long technical vocational education through which students can receive entry-level training, seek employment, advance their study, and enter the work force again as required by the technological changes. There is of course much to be done to better the industrial technical personnel development program. How to balance technical training with humanity development is that which should be focused on and that is what we are working at.

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